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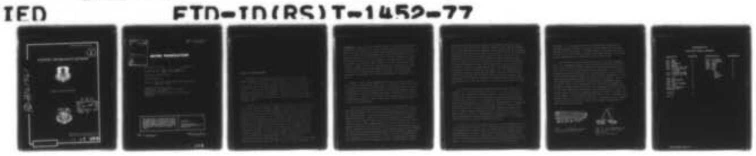

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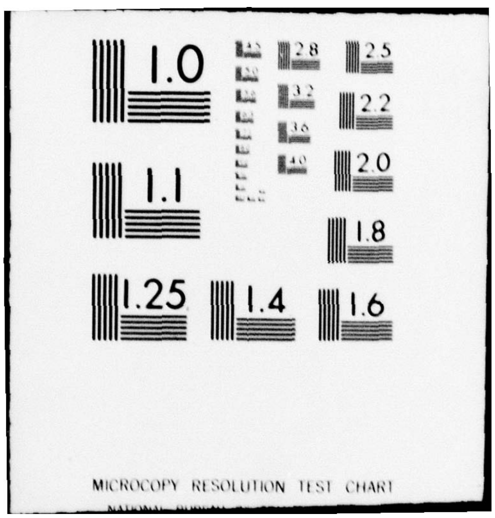
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FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

SATELLITE SOLAR STATION

FOREIGN TECHNOLOGY DIVISION

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SATELLITE SOLAR STATION

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SATELLITE SOLAR STATION

The sun is an unlimited energy source. The total solar radiated energy that the earth receives in a second reaches 4.12×10^{18} kilocalories. If this one-second energy is obtained by burning coal, then approximate 5,500,000 tons of coal are needed. If this much coal is used to generate electricity, it will be several tens of thousands of times more than the total electricity generated in the world. How to utilize solar radiated energy to generate electricity is a subject that man has studied for many years.

As early as the year 1953, men successfully made silicon solar cells which directly change sunlight to electricity. Later, more solar cells such as cadmium sulfide, cadmium telluride, gallium arsenide and so forth were developed, but the most popular one is still the silicon solar cell. Presently, nearly all artificial satellites and other space vehicles operating in the sky are using solar cells as their electrical source. There are all kinds of limitations on generating electricity by solar energy on earth, such as the changes of sunset and sunrise, the blockage of the cloud and fog, etc. But there is no difference of day and night in space; sunlight is there all the time. Of course, there is a small period of time during which the artificial earth satellite is blocked from sunlight by the earth while the satellite rotates around the earth, but this is only of short duration. For

instance, it takes a satellite which flies in an orbit 800 km from earth about 100 minutes to circle around the earth once and the satellite is blocked by the earth from sunlight for only 35 minutes. For a satellite in a synchronous orbit which is parallel to the equator and 35,800 km from the earth, the time required to circle the earth is the same as the earth's rotation, that is 23 hours 56 minutes 4 seconds to make a circle. For such satellite, the chance of being shaded from the sunlight by the earth is 45 days at about vernal equinox and autumnal equinox separately, and is no more than 72 minutes in a day. The solar cell can always transform the sunlight to electricity during the remainder of the time.

Thus, in 1968 someone suggested placing a solar electrical station in a synchronous orbit, using a large-area solar cell plate to transform sunlight to electricity, then using a special high-frequency tubal electricity generator to transform direct current to microwave electrical energy, and then transmitting it through an antenna to earth. On the ground, the receiving antenna receives the microwaves from the solar electrical station and distributes electricity to consumers.

From the economics point of view, it is only economical in that the satellite solar electrical station has large electricity-generating capability. The electricity-generating capability of the imaginary solar electrical station is two million to twenty million kilowatts. Shown in the title drawing is an imaginary eight million kilowatt solar electrical station; solar cell plates are set on both sides symmetrically, the total area is about 45 square kilometers, and the central part is the transmitting antenna with a diameter of one kilometer. The transmitting antenna consists of 800,000 special high-frequency power tubal microwave generators. The electrical energy converted from solar cells is transmitted by an antenna with an efficiency of 86%, a transmitting frequency of 3,000 MHz, and a wavelength of 10 cm. The microwave of this

frequency can almost pass through the ionosphere without attenuation, but attenuates into different degrees when passing through the troposphere due to the humidity. The diameter of the receiving antenna on the ground is 70 km; it can receive 90% of the microwave energy sent from the satellite solar electrical station. The ground antenna does not need to move; the "phaselock" technique could be used to "lock-on" the satellite solar electrical station. It has been mentioned above that the satellite solar electrical station is placed in a synchronous orbit, the operating cycle is the same as earth's rotation, the degree that the satellite solar electrical station rotates is the degree that the earth rotates. Therefore observing the satellite solar electrical station from the ground is the same as watching a communication satellite which is hanging in the sky and stays in the same position without movement.

The seven-kilometer-wide ground antenna shown in Fig. 1 is composed of a half-wave dipole metal net to catch the microwave energy. The received microwave energy is rectified by a solid-state diode, connected to a high-voltage direct-current network, and then distributed to the consumer. From the solar electrical station which generates electricity for transmission to the ground receiving station, the total efficiency can be as high as 68%. In other words the 8 million KW of power which the solar cells put out have a usuable power of about 5 million KW for the consumers after conversion, transmitting, receiving, rectification, and transmission. This much power is equivalent to the electrical energy required by several industrial cities.

A satellite solar electrical station is an enormous thing to be sent into synchronous orbit. From the present technical level, it is difficult to achieve for the time being. Someone thought of breaking the satellite solar electrical station into several sections which could be carried by the 72-ton space shuttle to an orbit at an altitude of 8,000 km load by load and installed in the space. After the satellite solar electrical station is put

together, it is transferred to the predetermined position in synchronous orbit driven by the ion rocket engine by utilizing its own electrical power. It seems possible to carry out such a project by the end of this century. The space shuttle to be used as the carrying tool is presently in the study stage.

The satellite solar electrical station is really enormous. Thus, it is suggested that it have an electrical relay satellite. The solar electrical station should be installed on earth where there is a lot of sunlight, such as in the desert. Or a nuclear electrical power station should be installed far fom the city at a place where there is almost no trace of human habitation. Thus, the heavy generating facility may remain on the ground. Only a very light metal net reflactor is sent into synchronous orbit, facing the earth, and transferring the ten million kilowatts of microwave energy which is sent from the ground electrical station to the place where the electricity is needed (Fig. 2). Thus, the weight of the satellite is greatly reduced; however, the area is still large. It is a square kilometer, and it must be divided into several parts to be placed in orbit and be installed in the space. Its realization will have to wait until further development of space delivery technology.

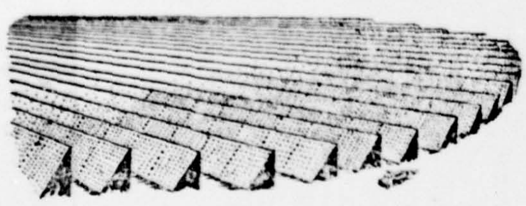

Fig. 1. An imaginary ground receiving antenna matrix.

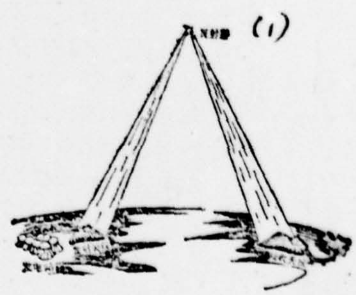

Fig. 2. The imaginary diagram of electrical relay satellite.
Key: (1) Reflector.

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